General

Title

Iatrogenic pneumothorax: percentage of iatrogenic pneumothorax cases per 1,000 discharges for patients ages 17 years and younger.

Source(s)

AHRQ QI research version 5.0. Pediatric quality indicator 5 technical specifications: iatrogenic pneumothorax rate. Rockville (MD): Agency for Healthcare Research and Quality (AHRQ); 2015 Mar. 8 p.

National Quality Forum measure information: iatrogenic pneumothorax rate (PDI 5). Washington (DC): National Quality Forum (NQF); 2013 Jul 2. 26 p.

Measure Domain

Primary Measure Domain

Clinical Quality Measures: Outcome

Secondary Measure Domain

Does not apply to this measure

Brief Abstract

Description

This measure is used to assess the percentage of iatrogenic pneumothorax cases per 1,000 discharges for patients ages 17 years and younger.

Rationale

This indicator is intended to flag cases of complications that arise due to technical difficulties in medical care, specifically those involving a pneumothorax.

Iatrogenic pneumothorax is a relatively frequent and potentially serious complication of procedures adjacent to the lung or pleural space. For example, 1.9% of critical care patients developed iatrogenic pneumothorax within 2 days after central venous catheter (CVC) insertion at 2 tertiary care hospitals

(Ayas et al., 2007). In another study from an academic center, 0.38% of feeding tube placements resulted in pneumothorax (Marderstein, Simmons, & Ochoa, 2004). A nationwide study of administrative data from 994 acute care hospitals across 28 states (Zhan, Smith, & Stryer, 2006) revealed that the rate of iatrogenic pneumothorax was 0.67 per 1000 hospitalized patients at risk, and procedure-specific rates varied from 2.68% for patients who underwent thoracentesis to 0.06% for those who underwent gastrostomy.

This measure focuses on a potentially preventable postprocedural complication, or adverse outcome.

Evidence for Rationale

Ayas NT, Norena M, Wong H, Chittock D, Dodek PM. Pneumothorax after insertion of central venous catheters in the intensive care unit: association with month of year and week of month. Qual Saf Health Care. 2007 Aug;16(4):252-5. PubMed

Marderstein EL, Simmons RL, Ochoa JB. Patient safety: effect of institutional protocols on adverse events related to feeding tube placement in the critically ill. J Am Coll Surg. 2004 Aug;199(1):39-47; discussion 47-50. PubMed

National Quality Forum measure information: iatrogenic pneumothorax rate (PDI 5). Washington (DC): National Quality Forum (NQF); 2013 Jul 2. 26 p.

Zhan C, Smith M, Stryer D. Accidental iatrogenic pneumothorax in hospitalized patients. Med Care. 2006 Feb;44(2):182-6. PubMed

Primary Health Components

Pediatrics; iatrogenic pneumothorax

Denominator Description

Surgical and medical discharges for patients ages 17 years and younger (see the related "Denominator Inclusions/Exclusions" field)

Numerator Description

Discharges, among cases meeting the inclusion and exclusion rules for the denominator, with any secondary International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes for iatrogenic pneumothorax (see the related "Numerator Inclusions/Exclusions" field)

Evidence Supporting the Measure

Type of Evidence Supporting the Criterion of Quality for the Measure

A clinical practice guideline or other peer-reviewed synthesis of the clinical research evidence

A systematic review of the clinical research literature (e.g., Cochrane Review)

One or more research studies published in a National Library of Medicine (NLM) indexed, peer-reviewed journal

Additional Information Supporting Need for the Measure

The incidence of Pediatric Quality Indicator (PDI) 05 has decreased somewhat over time, despite virtually no change in the underlying specification of the indicator: 0.28 per 1,000 eligible discharges in 1997, 0.19 in 2000, 0.21 in 2003, 0.18 in 2006, and 0.16 (preliminary) in 2008. Similarly, Friedman et al. (2011) used data from the Healthcare Cost and Utilization Project from 2000 to 2007 to examine trends in pediatric care. The overall rate of iatrogenic pneumothorax decreased 17.8% from 2000 to 2007, with a notable decrease in regional disparities (i.e., from 0.13 per 1,000 eligible discharges in the South and 0.30 in the Northeast in 2000 to 0.15 and 0.18, respectively, in 2007). However, the authors cautioned that present on admission data were not used and the sample of hospitals varied over the years. In any case, the recent decrease is thought to be a "success story" related to improved patient safety practices.

In a case control study using nearest-neighbor propensity score matching, the Agency for Healthcare Research and Quality (AHRQ) pediatric-specific Patient Safety Indicators (PSIs) were used to identify adverse events in 431,524 discharges from 38 freestanding, academic, not-for-profit pediatric hospitals affiliated with the Child Health Corporation of American and participating in the Pediatric Health Information System database in 2006 (Kronman et al., 2008). They reported a PDI 05 rate of 0.37 per 1,000 discharges, which is similar to the AHRQ reported rate of 0.44 per 1,000 discharges from children's hospitals for the same year. Records with a pressure ulcer (PU) event had mean excess length of stay of 3.39 days and mean excess hospital charges of $53,604, relative to matched controls. The excess charges came from all hospital cost centers, including pharmacy ($4,957), supplies ($889), laboratory ($3,958), imaging ($795), and other clinical activities ($5,562).

Several recent studies have focused on the potential to prevent these events. A meta-analysis of 6 randomized trials (Hind et al., 2003) with 579 participants showed that the risk of any procedural complication, including pneumothorax, is reduced when internal jugular (IJ) venous catheters are inserted with real-time ultrasound guidance (relative risk [RR] = 0.43; 95% confidence interval [CI] = 0.22 to 0.87). A subsequent randomized trial that involved 450 critically ill adults who underwent real-time ultrasound-guided cannulation of the IJ vein and 450 comparison patients for whom the landmark technique was used confirmed that ultrasound reduces the risk of pneumothorax (i.e., from 2.4% to 0%, P less than .001) and other complications (Karakitsos et al., 2006). Three randomized trials involving 167 infants (Calvert et al., 2003) also demonstrated that real-time ultrasound guidance reduces the risk of procedural complications during IJ cannulation (RR = 0.27; 95% CI = 0.08 to 0.91). For subclavian vein cannulation, the evidence that ultrasound guidance reduces the risk of procedural complications is less convincing because it comes from just 1 trial (RR = 0.10; 95% CI = 0.01-0.71) (Gualtieri et al., 1995).

The exact proportion of PDI 05 events that is preventable, with optimal procedural technique, is unknown. However, in one series of 148 confirmed cases from 28 participating hospitals in the National Association of Children's Hospitals and Related Institutions (Scanlon et al., 2008), 43 (29%) were deemed preventable, 53 (36%) were deemed nonpreventable, and 52 (35%) were characterized as having uncertain preventability. This determination was made independently by clinicians at each site, who lacked formal training but were guided by teleconference discussions. The authors concluded that the average children's hospital in the US reports 0.7 to 1.5 preventable PDI 05 events each year. In a previous review of 108 cases from 14 children's hospitals (Scanlon et al., 2006), using similar methods, 42% were deemed preventable, 39% were deemed unpreventable, and 19% were classified as "unable to determine"

Evidence for Additional Information Supporting Need for the Measure

Calvert N, Hind D, McWilliams RG, Thomas SM, Beverley C, Davidson A. The effectiveness and cost-effectiveness of ultrasound locating devices for central venous access: a systematic review and economic evaluation. Health Technol Assess. 2003;7(12):1-84. PubMed

Friedman B, Berdahl T, Simpson LA, McCormick MC, Owens PL, Andrews R, Romano PS. Annual report

on health care for children and youth in the United States: focus on trends in hospital use and quality. Acad Pediatr. 2011 Jul-Aug;11(4):263-79.

Gualtieri E, Deppe SA, Sipperly ME, Thompson DR. Subclavian venous catheterization: greater success rate for less experienced operators using ultrasound guidance. Crit Care Med. 1995 Apr;23(4):692-7. PubMed

Hind D, Calvert N, McWilliams R, Davidson A, Paisley S, Beverley C, Thomas S. Ultrasonic locating devices for central venous cannulation: meta-analysis. BMJ. 2003 Aug 16;327(7411):361. [6 references] PubMed

Karakitsos D, Labropoulos N, De Groot E, Patrianakos AP, Kouraklis G, Poularas J, Samonis G, Tsoutsos DA, Konstadoulakis MM, Karabinis A. Real-time ultrasound-guided catheterisation of the internal jugular vein: a prospective comparison with the landmark technique in critical care patients. Crit Care. 2006;10(6):R162. PubMed

Kronman MP, Hall M, Slonim AD, Shah SS. Charges and lengths of stay attributable to adverse patient-care events using pediatric-specific quality indicators: a multicenter study of freestanding children's hospitals. Pediatrics. 2008 Jun;121(6):e1653-9. PubMed

National Quality Forum measure information: iatrogenic pneumothorax rate (PDI 5). Washington (DC): National Quality Forum (NQF); 2013 Jul 2. 26 p.

Scanlon MC, Harris JM 2nd, Levy F, Sedman A. Evaluation of the agency for healthcare research and quality pediatric quality indicators. Pediatrics. 2008 Jun;121(6):e1723-31. PubMed

Scanlon MC, Miller M, Harris JM, Schulz K, Sedman A. Targeted chart review of pediatric patient safety events identified by the Agency for Healthcare Research and Qualityâ€™s patient safety indicators methodology. J Patient Saf. 2006;2:191-7.

Extent of Measure Testing

Reliability Testing

Data/Sample. Includes approximately 6 million pediatric discharges for 2,500 hospitals ("Healthcare Cost and Utilization Project [HCUP] State Inpatient Databases [SID]," 2008).

Analytic Method. The signal to noise ratio is the ratio of the between hospital variance (signal) to the within hospital variance (noise). The formula is signal / (signal + noise). The ratio itself is only a diagnostic for the degree of variance in the risk-adjusted rate systematically associated with the provider. Therefore, what matters is the magnitude of the variance in the "smoothed" rate (that is, the variance in the risk-adjusted rate after the application of the univariate shrinkage estimator based on the signal ratio).

Testing Results. What the data demonstrate is systematic variation in the provider level rate of 0.128 to 0.841 per 1,000 from the 5th to 95th percentile after a signal ratio of 0.463 is applied as the shrinkage estimator (that is, after accounting for variation due to random factors).

California data from 2005 to 2007, which included "present on admission" reporting, were used to determine the percentage of hospitals with patient volumes sufficient to readily use the Quality Indicator (QI) for tracking performance over time. Zero of 401 California hospitals (0.0%) had sufficient patient volume to detect a hypothetical doubling of the Pediatric Quality Indicator (PDI) 05 rate. This problem could be minimized by focusing public reporting of this indicator on hospitals that meet a minimum pediatric volume threshold, or by incorporating it into a more robust composite measure (Bardach, Chien, & Dudley, 2010).

Validity Testing

Data/Sample. The most recent study of the criterion validity of PDI 05 was based on a consecutive sample of 184 flagged cases from 28 participating hospitals in the National Association of Children's Hospitals and Related Institutions (NACHRI) from 2003 through 2005 (Scanlon et al., 2008). Records were reviewed independently by clinicians at each site, who lacked formal training but were guided by teleconference discussions. A previous review of 108 flagged cases from 14 self-selected children's hospitals in the NACHRI Pediatric Patient Safety Indicator (PSI) Collaborative (Scanlon et al., 2006) used similar methods.

Analytic Method. Calculation of the positive predictive value, which is defined as the percentage of reported events that are confirmed as true events based upon application of a "criterion (gold) standard." Sensitivity is defined as the percentage of all eligible events (based upon the same criterion standard) that are reported by hospitals in the administrative data set used for validation. In the cited studies, the criterion standard was based on review of randomly or chronologically sampled medical records by an experienced clinician, using a standard data collection tool and guidelines.

Testing Results. The larger, more recent study published in 2008 estimated a positive predictive value (PPV) of 80% (148/184), which is very consistent with the PPV estimates for the adult version of this indicator (e.g., 73% [95% confidence interval (CI), 64% to 81%] and 78% [95% CI, 73% to 82%] for PSI 06). Fewer details are reported from the earlier (2006) study, but Table 1 in that paper suggests a PPV of at least 61%.

False positive rates were low, as reported for PSI 15. Some false positives were due to complications that were actually present on admission (i.e., 19 of 36 false positives in the NACHRI study), which would automatically be excluded by users with "present on admission" (POA) data. (Current AHRQ PSI specifications assume that this data element is available.) Adjusting for the availability of POA data, the estimated PPV in the 2008 NACHRI study was 90%. The remaining false positives were mostly due to expected pneumothoraces in the course of procedures that did not trigger denominator exclusion or residual pneumothoraces after removal of a thoracostomy tube that had been placed for other reasons (e.g., elective surgery).

Face validity was systematically assessed using an expert panel process, as described in our original submission documents (McDonald et al., 2006). The methodology for the structured review was adapted from the RAND/UCLA Appropriateness Method and consisted of an initial independent assessment of each indicator by clinician panelists using an initial questionnaire, a conference call among all panelists, followed by a final independent assessment by clinician panelists using the same questionnaire. Specifically, this indicator was reviewed by a pediatric specialty panel with eleven pediatric clinicians, including one general pediatrician, one hospitalist, one critical care physician, one neonatologist, one infectious disease specialist, one hematologist oncologist, one cardiothoracic surgeon, one emergency medicine specialist, one interventional radiologist, and two surgeons. The panel unanimously recommended splitting the original indicator into two separate indicators: 1) iatrogenic pneumothorax (neonates), and 2) iatrogenic pneumothorax (non-neonates). The second indicator, which is presented here, examines all other pediatric patients, using an exclusion of both normal newborns and neonates with a recorded birthweight of less than 2500 grams. The neonatal indicator has less evidence regarding preventability and has not been submitted for National Quality Forum (NQF) endorsement.

Refer to the original measure documentation for additional measure testing information.

Evidence for Extent of Measure Testing

Bardach NS, Chien AT, Dudley RA. Small numbers limit the use of the inpatient pediatric quality indicators for hospital comparison. Acad Pediatr. 2010 Jul-Aug;10(4):266-73. PubMed

Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID). Rockville (MD):

Agency for Health Research and Quality (AHRQ); 2008.

McDonald K, Romano P, Davies S, Haberland C, Geppert J, Ku A, Choudhry K. Measures of pediatric health care quality based on hospital administrative data: the pediatric quality indicators. Rockville (MD): Agency for Healthcare Research and Quality (AHRQ); 2006 Sep. 130 p. [82 references]

National Quality Forum measure information: iatrogenic pneumothorax rate (PDI 5). Washington (DC): National Quality Forum (NQF); 2013 Jul 2. 26 p.

Scanlon MC, Harris JM 2nd, Levy F, Sedman A. Evaluation of the agency for healthcare research and quality pediatric quality indicators. Pediatrics. 2008 Jun;121(6):e1723-31. PubMed

Scanlon MC, Miller M, Harris JM, Schulz K, Sedman A. Targeted chart review of pediatric patient safety events identified by the Agency for Healthcare Research and Quality's patient safety indicators methodology. J Patient Saf. 2006;2:191-7.

State of Use of the Measure

State of Use

Current routine use

Current Use

not defined yet

Application of the Measure in its Current Use

Measurement Setting

Hospital Inpatient

Professionals Involved in Delivery of Health Services

not defined yet

Least Aggregated Level of Services Delivery Addressed

Single Health Care Delivery or Public Health Organizations

Statement of Acceptable Minimum Sample Size

Does not apply to this measure

Target Population Age

Age less than or equal to 17 years

Target Population Gender

Either male or female

National Strategy for Quality Improvement in Health Care

National Quality Strategy Aim

Better Care

National Quality Strategy Priority

Making Care Safer
Prevention and Treatment of Leading Causes of Mortality

Institute of Medicine (IOM) National Health Care Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Safety

Data Collection for the Measure

Case Finding Period

User may specify the time window; generally one calendar year.

Denominator Sampling Frame

Patients associated with provider

Denominator (Index) Event or Characteristic

Institutionalization

Patient/Individual (Consumer) Characteristic

Therapeutic Intervention

Denominator Time Window

not defined yet

Denominator Inclusions/Exclusions

Inclusions
Surgical and medical discharges for patients ages 17 years and younger. Surgical and medical discharges are defined by specific Diagnosis Related Group (DRG) or Medicare Severity (MS)-DRG codes.

Note: Refer to the original measure documentation for DRG and MS-DRG codes. See also the *Pediatric Quality Indicators Appendices*.

Exclusions
Exclude cases:

> Neonates with birth weight less than 2,500 grams (Birth Weight Categories 1 to 8)
> With a principal International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis code (or secondary diagnosis present on admission) for iatrogenic pneumothorax (see above)
> With any-listed ICD-9-CM diagnosis codes for chest trauma
> With any-listed ICD-9-CM diagnosis codes for pleural effusion
> With any-listed ICD-9-CM procedure codes for thoracic surgery
> With any-listed ICD-9-CM procedure codes for lung or pleural biopsy
> With any-listed ICD-9-CM procedure codes for diaphragmatic surgery repair
> With any-listed ICD-9-CM procedure codes for cardiac surgery
> Normal newborn
> Major Diagnostic Categories (MDC) 14 (pregnancy, childbirth, and puerperium)
> With missing gender (SEX=missing), age (AGE=missing), quarter (DQTR=missing), year (YEAR=missing) or principal diagnosis (DX1=missing)

Exclusions/Exceptions

not defined yet

Numerator Inclusions/Exclusions

Inclusions
Discharges, among cases meeting the inclusion and exclusion rules for the denominator, with any secondary International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes for iatrogenic pneumothorax

Note: Refer to the original measure documentation for ICD-9-CM codes.

Exclusions
Unspecified

Numerator Search Strategy

Institutionalization

Data Source

Administrative clinical data

Type of Health State

Adverse Health State

Instruments Used and/or Associated with the Measure

Unspecified

Computation of the Measure

Measure Specifies Disaggregation

Does not apply to this measure

Scoring

Rate/Proportion

Interpretation of Score

Desired value is a lower score

Allowance for Patient or Population Factors

not defined yet

Description of Allowance for Patient or Population Factors

The predicted value for each case is computed using a hierarchical model (logistic regression with hospital random effect) and covariates for gender, birthweight (500g groups), age in days (29 to 60, 61 to 90, 91+), age in years (in 5-year age groups), modified Centers for Medicare & Medicaid Services (CMS) Diagnosis-Related Group (DRG), and Agency for Healthcare Research and Quality (AHRQ) Clinical Classifications Software (CSS) comorbidities. The reference population used in the regression is the universe of discharges for states that participate in the Healthcare Cost and Utilization Project (HCUP) State Inpatient Data (SID) for the year 2008, a database consisting of 43 states and approximately 6 million pediatric discharges. The expected rate is computed as the sum of the predicted value for each case divided by the number of cases for the unit of analysis of interest (i.e., hospital). The risk adjusted rate is computed using indirect standardization as the observed rate divided by the expected rate, multiplied by the reference population rate.

Standard of Comparison

not defined yet

Identifying Information

Original Title

PDI 5: iatrogenic pneumothorax rate.

Measure Collection Name

Agency for Healthcare Research and Quality (AHRQ) Quality Indicators

Measure Set Name

Pediatric Quality Indicators

Submitter

Agency for Healthcare Research and Quality - Federal Government Agency [U.S.]

Developer

Agency for Healthcare Research and Quality - Federal Government Agency [U.S.]

Funding Source(s)

Agency for Healthcare Research and Quality (AHRQ)

Composition of the Group that Developed the Measure

The Agency for Healthcare Research and Quality (AHRQ) Quality Indicator (QI) measures are developed by a team of clinical and measurement experts in collaboration with AHRQ. The AHRQ QIs are continually updated as a result of new research evidence and validation efforts, user feedback, guidance from the National Quality Forum (NQF), and general advances in the science of quality measurement.

Financial Disclosures/Other Potential Conflicts of Interest

None

Endorser

National Quality Forum - None

NQF Number

not defined yet

Date of Endorsement

2015 Jan 5

Adaptation

This measure was not adapted from another source.

Date of Most Current Version in NQMC

2015 Mar

Measure Maintenance

Measure is reviewed and updated on a yearly basis

Date of Next Anticipated Revision

Spring 2016 (version 6.0, including International Classification of Diseases, Tenth Revision, Clinical Modification [ICD-10-CM] and International Classification of Diseases, Tenth Revision, Procedure Coding System [ICD-10-PCS] compatible software)

Measure Status

This is the current release of the measure.

This measure updates previous versions:

> AHRQ QI. Pediatric quality indicators #5: technical specifications. Iatrogenic pneumothorax rate [version 4.4]. Rockville (MD): Agency for Healthcare Research and Quality (AHRQ); 2012 Mar. 5 p. AHRQ quality indicators. Pediatric quality indicators: technical specifications [version 4.4]. Appendices. Rockville (MD): Agency for Healthcare Research and Quality (AHRQ); 2012 Mar. 61 p.

Measure Availability

Source available from the Agency for Healthcare Research and Quality (AHRQ) Quality Indicators (QI) Web site [   ].

For more information, contact the AHRQ QI Support Team at E-mail: QIsupport@ahrq.hhs.gov; Phone: 301-427-1949.

Companion Documents

The following are available:

> AHRQ quality indicators. Pediatric quality indicators (PDI) parameter estimates [version 5.0]. Rockville (MD): Agency for Healthcare Research and Quality (AHRQ); 2015 Mar. 98 p. This document is available from the AHRQ Quality Indicators Web site [   ].
> ARHQ quality indicators. Pediatric quality indicators benchmark data tables [version 5.0]. Rockville (MD): Agency for Healthcare Research and Quality (AHRQ); 2015 Mar. 13 p. This document is available from the AHRQ Quality Indicators Web site [   ]
> AHRQ quality indicators. Pediatric quality indicators composite measure workgroup. Final report. Rockville (MD): Agency for Healthcare Research and Quality (AHRQ); 2008 Mar. various p. This document is available in PDF from the AHRQ Quality Indicators Web site [   ].
> HCUPnet: a tool for identifying, tracking, and analyzing national hospital statistics. [Web site]. Rockville (MD): Agency for Healthcare Research and Quality (AHRQ); [accessed 2015 Sep 10]. HCUPnet is available from the AHRQ Web site [   ].

NQMC Status

This NQMC summary was completed by ECRI Institute on December 28, 2007. The information was verified by the measure developer on March 31, 2008.

This NQMC summary was updated by ECRI Institute on June 25, 2010.

This NQMC summary was reviewed and edited by ECRI Institute on July 15, 2011.

This NQMC summary was retrofitted into the new template on July 19, 2011.

This NQMC summary was updated by ECRI Institute on February 28, 2013 and again on December 1, 2015. The information was verified by the measure developer on January 19, 2016.

Copyright Statement

Production

Source(s)

AHRQ QI research version 5.0. Pediatric quality indicator 5 technical specifications: iatrogenic pneumothorax rate. Rockville (MD): Agency for Healthcare Research and Quality (AHRQ); 2015 Mar. 8 p.

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